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MECHANISM VERSUS VITALISM, IN THE DOMAIN OF PSYCHOLOGY.

I. DEFINITIONS.

IT is well, at the outset, to understand clearly what is meant by vitalism and mechanism. Both terms imply activity or change; they refer to processes in nature, not merely to static configurations. The two terms represent more or less contrasted types of process. The point at issue is whether both types actually occur in nature, or whether the changes and activities which take place in the universe may not all be reduced to a single type—the mechanistic.

Mechanism.—The distinctive characteristic of mechanistic processes is that the course of events in the sequence is rigidly *determined.* Given a certain set of antecedents, one and the same series of consequents will follow every time. If the total conditions of the situation at a given instant are known (or in so far as they are known), the results can be predicted unequivocally. If the conditions are not known to us, we nevertheless believe that the course of events in a mechanistic system is fixed, certain, unambiguous, determinate, unequivocal.

According to this definition of mechanism, which seems to be the prevailing conception of the term, and is my interpretation of its use in our Basis of Reference, a mechanistic process may be represented graphically as a unilinear series. An indeterminate process is one in which the outcome is not wholly unequivocal. Such a series may be pictured graphically by a line which forks or branches at certain points, representing alternative courses of events beyond these points.[1]

Physical and chemical phenomena, as understood today, are typical cases of determinate activity. The course of events in these domains is generally believed to be unequivocal. These sciences furnish the practical basis upon which our notion of mechanism is founded. When we speak of mechanistic processes we have usually in mind activities of the physicochemical type. But the two notions are not identical. So far as present knowledge goes, certain processes in nature, such as the growth of organisms and voluntary acts of human beings, though strictly determinate, *may* involve activities (or forces) of a 'higher type' than the physicochemical. Mechanism represents a generic type; physicochemical mechanism is a specific type which may or may not exhaust the genus.

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[1] See diagram in Bergson, *Time and Free Will,* Pogsan trans., p. 176.

Vitalism.—While the definition of mechanism given above is generally accepted, there is no agreement as to the connotation of vitalism. The name is applied by different writers to several mutually incompatible views which seek to explain vital phenomena in other terms than those of physicochemical activity. In the literature we find three distinct types of theory which take issue with physicochemical mechanism as a general explanation of natural processes. They may be classed together, though the third type is not, strictly speaking, a form of vitalism.

1. *Vital Indeterminism.*—Vital phenomena are held by some to be not entirely 'unilinear'; at certain points two or more alternative courses are (supposed to be) possible, the actual outcome in any given instance being unpredictable. In earlier days this notion was extended to inorganic nature; the actual results in certain cases were ascribed to 'chance' or 'caprice.' So far as I know, this view has no adherents among contemporary scientific thinkers. Equivocal causation is limited today to organic phenomena; the selection or choice is attributed either (*a*) to autonomy, *i. e.*, self-determination of the creature, or (*b*) to the operation of some non-physical agent working upon the material substance of the organism. These qualifications of indeterminism virtually place the interpretation in the next class.[1]

2. *Vital Force.*—Professor Wm. E. Ritter defines vitalism as

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[1] As a philosophical theory only—not for purposes of scientific investigation. Driesch, *e. g.*, holds that "two systems absolutely identical in every physicochemical respect may behave differently under absolutely identical conditions, in case that the systems are living systems." (Quoted by Jennings in *Science*, 1912, 36, p. 435.) Driesch regards this view as "experimental indeterminism," but not as "absolute indeterminism." *Cf.* Bergson's illustration cited above.

the view that "something absolutely new and novel came into the world when living beings came, and that this came as a special force, or principle, or factor . . . not material."[1] While this force or factor has not always been conceived as determinate in its activity, it is today generally regarded as *subject to certain laws.* Its workings are held to exhibit certain uniformities, though these are not of the physicochemical type. The vital force is variously designated as *élan vital* (Bergson), entelechy (Driesch), or soul (W. McDougall).

The activity of the 'vital force' is generally characterized as *teleological.* This term is variously defined. Usually it signifies that the choice is determined with reference to something 'yet to come'—that the outcome is not merely the resultant of past conditions.

3. *Non-mechanistic Relationship.*—Certain writers who reject the notion of a specific vital force, nevertheless believe that the activities of organisms are not wholly explicable in physicochemical terms. According to Kant: "Some products of material nature cannot be judged to be possible according to merely mechanical laws. (To judge them requires quite a different law of causality, namely that of final causes.)"[2] Hobhouse regards a living being as a system of "forces in which mechanical relations are qualified by teleological relations;"[3] and Professor Henderson somewhat similarly defines biological organization as consisting in "a teleological and non-mechanical *relationship* between mechanical things and processes."[4]

Professor Lovejoy describes this type of vitalism as the general doctrine that "the action of living bodies is not strictly a function of the number and spatial configuration of the particles composing them at any instant."[5] Professor Jennings points out, however, that the same may be said of non-living systems also;[6] so that this view, while it is anti-mechanistic, need not take a vitalistic form. Both Hobhouse's and Henderson's conceptions of non-mechanistic relations might be similarly extended to the inorganic realm. Henderson seems to imply this broader notion of teleology in his discussion of the "order of nature."

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[1] "Controversy between Materialism and Vitalism," *Science*, 1911, 33, p. 438.

[2] *Kritik of Judgment*, trans. by Bernard, p. 294.

[3] *Development and Purpose*, p. 329, note. (Quoted by Henderson.)

[4] "Teleology of Inorganic Nature," *Philos. Rev.*, 1916, 25, p. 278.

[5] "The Meaning of Vitalism," *Science*, 1911, 33, p. 612.

[6] "Doctrines Held as Vitalism," *Amer. Natural.*, 1913, 47, p. 394.

II. THE CASE AGAINST MECHANISM.

The opposition to mechanism as a complete explanation of the processes which occur in nature is thus seen to be of different degrees. The three anti-mechanistic attitudes may be summed up as follows: (1) Certain processes in nature are not determinate. (2) Certain activities of organisms are determined in part by a force or agent which is not physicochemical in character. (3) Physicochemical mechanism prevails universally, but it does not afford a *complete* explanation of certain natural processes; the mechanistic explanation needs to be supplemented by a teleological explanation, which takes account of relations belonging to a different order or dimension from the mechanistic.

The mechanist, on the other hand, believes that the weight of scientific evidence favors an explanation of natural processes stated wholly in physicochemical terms. According to the mechanistic interpretation, not only inorganic phenomena, but all phenomena of organic life, including those in which human consciousness is concerned, are strictly determinate and belong to the physicochemical type.

The case against mechanism is based chiefly upon four lines of argument. (1) *Inconceivability:* A thorough-going mechanistic interpretation of nature is inconceivable and impossible. (2) *Organization:* Mechanism does not explain certain observed characteristics of growth and regulation in organisms. (3) *Voluntary Selection:* Conscious introspection demonstrates that voluntary choice in human beings is not mechanistically determined. (4) *Teleology:* The adaptive character of behavior is not fully describable in mechanistic terms.

These arguments are used alike by all classes of opponents to the mechanistic standpoint. We shall examine them in turn in the remainder of this paper.

The Argument from Inconceivability.—The difficulties which meet us when we endeavor to reach a clear conception of mechanism are not to be ignored. They are such as occur when any new scientific principles are formulated which appear to be at variance with familiar but more limited generalizations. When the theory of the earth's spherical shape was first propounded it was difficult to imagine how men could live at the antipodes without 'dropping off.'

That many such inconceivabilities and absurdities have been rendered conceivable and have eventually been adopted diminishes the weight of this argument. Yet the opponents of mechanism today lay considerable emphasis on the difficulty. Not merely do they point out the need of greater explicitness in defining and describing mechanism; but they assert that the theory at certain points is inconceivable, impossible, or absurd. Such an argument may be characterized as pseudological.

The Kantian logic bristles with this type of reasoning. The passage quoted above is an instance in point. "Cannot be judged" is one shearing-blade of its antinomy; the opposite blade with its "must be judged" is equally sharp. If we smooth down the "cannot" and the "must," the antinomy no longer cuts.

The contemporary neo-Kantians follow in the Master's footsteps. Hobhouse asserts that "the actions of living beings are not explicable in mechanical terms, and we are compelled by the evidence to admit a teleological factor."[1] He may be justified in arguing that these actions *have not yet been fully explained;* but to characterize them as inexplicable is to spar with brass knuckles.

Driesch, for all his scientific training, uses this type of argument profusely: "A theory like Weismann's is impossible."[2] "It would be nonsense to apply the concept of 'quantity' and 'measure' to something which has only to do with the *arrangement* of a manifoldness."[3] "How could a 'machine' be divided and divided and—always remain the same?"[4] As a call for 'more light' such arguments deserve respectful attention. As a *reductio ad absurdum* they are not impressive.

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[1] *Development and Purpose*, p. 329 note.

[2] *Problem of Individuality*, p. 13.

[3] *Ibid.*, p. 35.

[4] *Ibid.*, p. 22. *Cf. Science and Philosophy of the Organism*, Vol. I, pp. 138–149; note the weakness of his argument if the assertion of necessity be eliminated.

W. McDougall's arguments in certain places indicate the same mental attitude: "The behavior of animals . . . is everywhere characterized by certain features which seem to present insuperable difficulties to all attempts at purely mechanical explanation."[1] "Mental chemistry is an inadmissible notion;" it is "strictly absurd."[2] "The difficulties of phenomenalistic parallelism are then very great, indeed insuperable."[3] "Such a state of things [as correlation of pain with beneficial reactions and of pleasure with detrimental reactions] would seem to us profoundly irrational and absurd."[4]

With the argument from inconceivability may be joined its converse, the argument from *a priori* necessity, so familiar to readers of Kant. Both arguments strike the scientist as pseudological. Such voluntaristic terms as *necessary* and *impossible* exert an undue logical pressure which even the out-and-out determinist resents.

The solution of the problem before us, as of any other scientific problem, depends upon *empirical* evidence. The function of logic is merely to imitate in thought the formal relations which prevail throughout the universe. The data of knowledge are drawn from the world about us; our rôle as rational beings is to arrange these data into orderly systems which *tally with the formal relations found in nature.* Pseudological devices carry us away from such correspondence between thought and nature.[5]

The Argument from Organization.—The second indictment against mechanism rests upon the phenomena of growth and other vital processes observed in organisms. According to the vitalists these processes are inconsistent with a strictly mechanistic theory. This line of argument has been developed most systematically by Driesch. Certain crucial experiments demonstrate, in his opinion, that each cell in the organism is "equipotential"; that is, it is capable of building up an entire organism. But, as a matter of fact, he points out, most cells develop only into some specific part of the organism, and the development of each cell harmonizes with that of the other cells in the organism. This would indicate, in his judgment, that the course of development is not wholly physicochemical, but is in some way controlled or directed by a non-physical agent—an entelechy.

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[1] *Body and Mind*, p. 258.

[2] *Ibid.*, p. 283.

[3] *Ibid.*, p. 160.

[4] *Ibid.*, pp. 324–325.

[5] In fairness we should note an equally illegitimate tendency on the part of mechanists to characterize the vitalistic position as a phase of mysticism or magic.

The evidence for mechanism on this count has been exhaustively presented by Jacques Loeb in a recent work, *The Organism as a Whole,* to which the reader is referred. According to this array of evidence the phenomena of organic life *do* admit of interpretation in strictly physicochemical terms, so far as scientific research has examined them. The hypothesis of a guiding entelechy appears to be quite as redundant as the hypothesis of an agency directing the movements of the planets in their orbits.

In addition to this direct empirical evidence for the mechanistic character of vital processes, we may notice certain weaknesses in Driesch's argument. (1) His statement of equipotentiality is broader than the facts warrant. The germ cells and certain of the cells which arise in *early* development do indeed appear to be capable of producing an entire organism. But many of the cells which arise in *later* stages of growth are more specialized. They appear capable of producing only certain specific organs or certain kinds of tissue. In the frog a certain type of cell, however situated, develops only into a leg. In man the nerve cells, blood cells, etc., produce only tissues of one type. Such cells are not equipotential.

(2) Driesch's conception of 'mechanism' is too narrow. The machines devised by man are of two distinct sorts—*constructing* machines and *operating* machines. The organism is at once a building mechanism and a working mechanism. The individual cells build up the organism and the organism as a whole performs certain operations of reaction upon the environment. Driesch does not seem to recognize that a mechanism may combine both features.

(3) The structural form which arises in organisms by growth

may be due to the interaction of cells upon one another. The development of any given cell is inhibited or modified by the action of the whole organism upon it. This would explain the "harmonious" development of the entire system as readily as Driesch's entelechy.

The two remaining lines of attack upon mechanism (volition and teleology) touch upon the sphere of psychology and will be examined in greater detail.

III. THE ARGUMENT FROM VOLUNTARY SELECTION.

The supposed autonomy of consciousness in determining action is used to support the view that vital phenomena are likewise autonomous or self-determined in certain respects. If volition proves to be physicochemically determined, this presumption disappears.

The Neurology of Deliberation.—It is now generally admitted that the thoughts which precede voluntary muscular activity depend in some way upon cerebral activity. There are three alternative interpretations of this relation: (1) Thought and neural processes are regarded by some as two *distinct* but *interacting* series of phenomena. (2) They are believed by others to constitute two *independent, parallel* series. (3) They are held to constitute *one series*, which may be observed subjectively as conscious experience and objectively as neural activity. The third view appears to accord with the observed facts, and seems preferable under the rule of parsimony.

The subjective experience of thought consists in a succession of mental states whose causal relation is not directly observed. If the series of events is mechanistically related, the causal description should be expressible in terms of the neural processes which are identical with the conscious experiences. As yet these neural processes have not been measured. That nerve impulses exist we know, and we have considerable knowledge of their pathways.

While an objective description of the process of 'voluntary selection' is still more or less hypothetical, it may be stated in mechanistic terms as readily as in terms of an animistic agency.

During the period of deliberation which precedes volition neural impulses travel now along one path (or set of paths) now along another among the cortical centers. When a neural impulse reaches a motor synapse of low resistance, discharge takes place and certain muscles are contracted. According to the mechanistic view both the central course of the impulse (deliberation) and the motor discharge (volition) follow the line of least resistance.

At least three objections are raised to this as a complete explanation[1] of the occurrence. (1) The succession of thoughts is determined in part by our attitude and conscious endeavors· (2) The actual initiation of the act is a matter of conscious control. (3) We are conscious at the time, or later, that we might have acted otherwise.

Attitude lends itself, however, to description in neural terms. The course of the nerve impulse is determined not merely by the sum-total of present stimuli; it depends quite as much upon past experience. The resistance at each synapse is modified by the impulses which have traversed it in the past, and the sum-total of these modifications constitute the general *set* of the nervous system. This neural set, in subjective terms, is our *attitude*. Laboratory investigations have demonstrated that associations of various types are formed according to certain regular principles. So far as can be judged, each association follows a line of least resistance, which is determined by habit (neural set) and present stimulation.

Conscious endeavor to deliberate is one phase of attitude. In neural terms it is a *set* in some direction. It means that certain central synapses have been made permeable, so that the impulse passes from center to center instead of finding at once the motor outlet.

If we observe intently the actual initiation of a voluntary act (the so-called *fiat*), we find it characterized by extremely vivid consciousness. *Unless* it is intently observed the action takes place of itself. In ordinary cases, then, the neural activity of volition means simply the passage of the impulse into a motor pathway through a permeable synapse. In certain specific cases this passage is preceded by an *intensive summation* of nerve impulses, and this is the neural equivalent of the *fiat*.

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[1] As here given the "explanation" is schematic and incomplete. To work out the neural details would carry us beyond the space allotted to this discussion.

In attempting to describe these phenomena the real difficulty seems due to the complexity of the occurrences, not to their peculiar character. We are dealing with a vast plexus of impulses and resistances. To account for them all is practically beyond our power. Like the problem of three bodies in physics, the outcome is practically unsolvable, but it is nevertheless rigidly determinate.

The Temporal Fallacy.—The notion of 'freedom'—of the indeterminateness of volition—appears to rest upon a faulty observation of the time relations of conscious experience. Choice implies that two or more alternative courses of action are presented in consciousness, of which one is selected by the individual. The fallacy consists in assuming that these alternatives are presented in all their strength at once.

When I debate whether to spend my vacation in the mountains or at the seashore, the reasons for and against each course are reviewed successively, not simultaneously. If there are strong motives for each, these motives are considered in turn. When the decision is actually reached it is due to the motives which are strongest at that time. I may afterwards feel that I might have chosen the other course quite as readily. But this is because the motives as *now presented* are different in strength from what they were at the time of decision. The problem of expense may weigh more heavily than it did when a salary check was just deposited; the wishes or welfare of some member of the family may now appear in a stronger light. I read back the present situation into the earlier; I appear to have chosen a line of greater resistance, because this line offers greater resistance at present. Hence the belief that the choice is guided by 'my will' rather than determined by the total situation.

When one picks up a hand at bridge one finds a certain combination of thirteen cards—one out of many million possible combinations. One feels that one might equally well have drawn quite a different assortment. What do we mean here by 'possible' and 'might'? Merely that a different shuffle would yield a different result. The shuffle *is* different next time, and the hands are different. But the two shuffles are successive, not simultaneous. The possibilities are successive—the 'might' refers to a different situation from the present. In every deal the order of cards is determined by the shuffle; it is a matter of physical forces operating on each card separately and modifying their mutual relations.

Here the situation determines one specific outcome from among many, composing a large homogeneous group, others of which are determined at other times as the situation varies. This is what we mean by *choice* or *selection* from among a number of 'possible' alternatives. The same conception of choice may be adopted in the case of human volition.

To test the determinateness of voluntary selection we should repeat the action under precisely the same conditions. Such a test, however, is scarcely ever practicable. We do not succeed in shuffling a pack twice the same way. Similarly, the situation preceding voluntary choice is always novel in certain essential particulars. Nevertheless, a situation may be new to the individual, and yet may be substantially repeated in different individuals. The temptation to marry, the temptation to commit a crime of some sort, occurs to many persons at one time or another. Mass statistics on both of these phenomena are available. They exhibit remarkable regularity from year to year in a given environment. Even the number of suicides in a community is surprisingly uniform—and this is certainly a new situation in each individual instance. In the case of marriage also the situation is generally novel.[1] Variations in the statistics from season to season and from year to year indicate that the selection is largely determined by temperature and climatic conditions, by food supply, and by factors of the social environment. That is, given an individual's inherited disposition, his choice of conduct in the matter of marriage, crime, and suicide is 'regulated' by environmental conditions, not by his arbitrary fiat.

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[1] The statistics do not indicate the number of 'temptations' which are resisted; but this does not affect the argument.

After studying these statistics the writer is more firmly convinced that volition is completely determined by physicochemical antecedents than he is of the fact that inanimate nature is mechanistically controlled. My 'luck' at cards is more difficult to explain without assuming a guardian angel or a malignant demon, than my conscious, voluntary actions.

It is admitted that the evidence does not *demonstrate* the falsity of the animistic interpretation. In every case, organic and inorganic, two alternative explanations are offered: (1) regularity of action, ascribed to an unstable equilibrium of related units in a system; (2) irregular changes, due to an agency outside the material system working upon the units. For the scientist the former interpretation presents the line of least resistance.

IV. The Argument from Teleological Activity.

The vitalistic hypothesis claims support in the fact that organic phenomena bear reference not merely to their antecedents in the past but to future conditions and situations. This is true not only of conscious behavior but of growth and other vital phenomena. I plan and execute my actions with reference to the coming vacation. The development of the embryo yields organs which are devoid of present utility but which later will serve to nourish and protect it. Our description of behavior and growth is incomplete if we merely trace the causal sequence as we do in inorganic processes. The scientific treatment of vital phenomena involves taking into account the future outcome as well as the antecedents.

This is only part of the story, however. In the case of behavior the conditions are extended in *both* temporal directions. The creative activity often has reference to the more or less remote past as well as to the future. A bird becomes gun-shy as a result of some experience. Thereafter when she sees a gun her reactions are conditioned not merely by present stimuli, but by the residual effects of the earlier situation. The mnemonic factor enters into our explanation of behavior in some form or other—either as neural set or as memory image.

There is also an extension of the *spatial* factors in behavior, though this is not so obvious. An organism reacts to distant stimuli, or rather to distant situations. We converge the two eyes with reference to a certain 'depth.' When the conductor shouts 'All aboard,' we run faster if we are further away from the train. We reach to right or left according to the direction of the object and put forth greater or lesser effort according to its degree of remoteness from us.

The word *teleology* may be used to denote this temporal and spatial extension of the conditions in certain organic phenomena.[1] The recognition of teleology by science does not *ipso facto* imply acceptance of indeterminism. Neither does it involve the admission of exceptions to the general principles of physicochemical action. Teleological activity may be described in terms which harmonize completely with our notions of physical causation. The conception of mechanism is broadened somewhat, but we find no discontinuity-point separating the physicochemical sphere from phenomena of a 'higher order.'

Distant-reception.—The principal distant senses of animals are sight, smell, and hearing. In each of these the stimuli come from objects or sources more or less remote from the creature. The stimuli travel toward the animal and affect the appropriate receptor. The stimuli as such are not distant, but the source remains distant and *continues to send out waves or emanations* toward the receptor. The situation is analogous to telegraphy, where a transmitting operator manipulates the key and a receiving operator, perhaps a thousand miles away, receives the message. The transmitter remains at a distance during the entire operation, but his activity and the activities of his instrument play an essential rôle in the process. A complete scientific description of telegraphy involves reference to the source of transmission.

Similarly, distant reception and the resulting reactions are not completely described in terms of the *impinging* stimulus. The distant source is an essential factor to be considered. In explaining telegraphy the recognition of the distant source implies no modification of the laws of causation. It merely indicates a certain complication of the causal processes in such types of activity. The same appears true in distant-reception.

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[1] The two terms, *teleology* and *purpose*, are usually employed interchangeably. But *purpose* connotes temporal extension only. On etymological grounds the meaning of teleology may be broadened to include spatial extension of the conditions as well.

Memory.—The mnemonic factors in the antecedents of behavior are not present stimuli, but dispositions of some sort in the cortical tracts. When I recite 'Mandalay' or steer a sailboat around a buoy, the immediate stimuli are not the sole causal factors. Past experiences have altered in some way the central synapses if not the neural substance itself. These 'prepared' central conditions are essential factors in the process; a scientific description of my activity involves taking them into account. This may be expressed in various ways. If may be said (1) that my present cortical set is a factor in my activity; or (2) that my memory of the poem or of the art of sailing enters into the process; or (3) that my past experiences in memorizing the poem or learning to sail are one of the antecedents of the present action. These are all abbreviated descriptions of the temporal extension.

The third form of statement is the most satisfactory, since it emphasizes the earlier occurrences which produced the cortical set and built up the memory. To describe the mnemonic factor merely in terms of present neural dispositions is to miss an essential point. Memory is conditioned by the *original experiences* which produce the set, in the same way that perception is conditioned by the *distant objects* which generate the stimuli.

To say that my reading of Mandalay years ago is one of the 'essential' antecedents of my present memory experience does not imply that time is syncopated—that the 'past' is 'present.' The causal sequence holds in full mechanistic form. But in describing memory phenomena the statement is abbreviated for convenience. Just as we say 9 × 6 = 54, instead of adding 6 to 6 again and again, so we speak of the original sensory experience as a direct antecedent of the present recall.

Purpose.—When we act with reference to a future situation the causal relation is more complex. In a former paper this type of activity was examined at some length.[1] Briefly, purposive actions depend upon distant-reception and memory. When a ball is coming toward me I *prepare* to catch it. Part of the future situation is already given through *distant-reception*: I see the ball coming before it reaches my hands. Part of the future situation is also given by the *memory* factor: I represent the coming situation in terms of similar past experiences.

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[1] "A Study of Purpose," *J. of Phil., Psychol.*, etc., 1916, 13, Nos. 1, 2, 3.

In the article referred to, purpose was defined as an "inversion of the temporal order." This is merely another shorthand formulation. In ordinary causal series the order would be (1) sight of the object, (2) contact, (3) reaction of some sort, such as grasping the ball, eating food, etc. In purposive action part of the reaction (3) precedes the contact (2). Professor Perry[1] points out that in the case of a dog chasing a rabbit the digestive process actually begins before the dog catches his prey. Here the reaction is started before the significant part of the stimulus occurs. Such an inversion of order is characteristic of purpose; it is an *anticipatory* reaction, but the process is mechanistically performed.

Purposive activity is thus seen to be a special type of causation, not a mode of change opposed to the causal type. The same was found true in the case of memory and distant-reception. Teleology in general, then, is a specialized form of causal process, which arises through certain extensions of the spatial and temporal range of the antecedents. Only the complexity, it appears, hinders us from describing the process completely in terms of physicochemical mechanism.

The Pattern Concept of Teleology.—Driesch offers as one of his arguments for vitalism the fact that organisms present certain peculiar patterns or forms. Professor Henderson, while denying the truth of vitalism, also emphasizes the pattern or order of certain phenomena in the universe.

These and the more or less similar views of Bosanquet, Hobhouse, and others indicate a sense of dissatisfaction with the postulates of physicochemical mechanism. With the exception of Driesch the authors mentioned admit the universality of mechanistic causation. They believe that the causal process is supplemented in some way by another factor which belongs to a different order.

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[1] "Docility and Purposiveness," *Psychol. Rev.*, 1918, 25, p. 16.

Bosanquet conceives this factor to be the principle of Value, and makes Teleology a subform of this principle. If teleology "is to retain a meaning, . . . it must fall back on the characteristics of value which, apart from sequence in time and from selected purposes, attach to the nature of a totality which is perfection."[1] Psychophysics points the way to a scientific definition of "value," but "a totality which is perfection" conveys no more meaning to the present writer than "a thirteen which is redness."

Driesch's expositions are clear if not convincing. He illustrates his pattern concept by a diagram.[2] On one side are sixteen units arranged to form a square—a regular homogeneous pattern; on the other side these units are arranged in trident form to represent roughly the shape of a plant. The latter form, he believes, can be derived from the homogeneous arrangement only by the action of some non-spatial agency.

This argument, indeed, reaches beyond the sphere of the organic. If the specific forms of organic species are puzzling to account for, the contour of certain inorganic systems is no less so. Why, for example, the peculiar outline of the North American continent? How explain, from homogeneous matter, the pyramidal shape of the Matterhorn, marking the boundary between three great linguistic stocks, each of which terminates at one of the three bases? How account for the preponderance of certain chemical elements in the world and the rarity of others?

Professor Henderson sees the implications of this reasoning and accepts them. Without denying the universality of mechanism in nature, he points to certain facts as evidence that a preëstablished eternal pattern or order exists in the cosmos. In the constitution of the three common elements, C, H, and O, and of certain of their compounds, and in the wide distribution of these elements and compounds, he finds evidence of a "teleological" factor inherent in the universe itself. We need not repeat his catalogue of these peculiar properties, which he describes as *maxima*, as the "fittest possible" for the fostering of organic life.[1]

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[1] *Individuality and Value*, p. 126.

[2] *Problem. of Indiv.*, p. 51.

We may raise at least two objections, however, to Professor Henderson's argument. In the first place it is *ex post facto*. The evolutionist holds that organic life has grown up *as it has* as a result of conditions which *actually exist*. If carbon were absent or rare, possibly another type of organism would have evolved, based upon silica compounds. If the properties of elements had been otherwise, we might expect to find different types of organisms, exhibiting different characteristics. If the earth's surface were mainly land, possibly fresh-water or aerial organisms would have arisen earlier than marine types. In other words, evolution is a process of adaptation to the *given* environment. Whatever environment is present is presumably *fit* for the types of organism which evolve within its limits.

But there is another weightier objection to the argument that the present environment manifests maximum fitness for *any* form of life. The cosmic processes apparently result sooner or later in solidifying any given world. The moon no longer supports life. It is believed that our own earth will also grow cold in time and will no longer afford a habitat for any kind of organic life. If we are seeking for *maxima* of fitness, here is at least one point where the actual physical constitution of the cosmos fails us. It does not rise above the minimum. One may therefore regard Professor Henderson's enumeration of characteristics as an interesting catalogue—and nothing more. It does not establish a *maximum* fitness in the order of nature.

Teleology and Fitness.—One important fact remains to be noticed in connection with organization and behavior. Organic evolution is an orderly process—just as physical and chemical processes are orderly; but a further notion, in addition to "regularity," is needed to bring out the full meaning of organic phenomena. This is variously expressed as 'adaptation,' 'adaptiveness,' 'adaptedness,' 'adjustment,' 'suitability,' 'fitness.' The growth of organisms brings into existence certain structures which *meet the conditions* of the environment. Instincts are evolved which are *fitted* to prolong life. Through the learning-process habits are developed in the individual which are *adapted* to his situation in life.

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[1] *The Fitness of the Environment*, chaps. VII, VIII; *The Order of Nature*, chaps. VIII–X.

Fitness may be regarded as a dynamic harmony in nature, which supplements the static harmony of physical phenomena and inorganic chemistry. The term 'harmony,' however, is no easier to define than 'fitness.' What does the general notion of fitness or harmony in organic phenomena imply?

The notion of fitness as applied to organisms implies their viability; as applied to growth-processes and behavior it implies a result which increases the organism's viability. To this extent the phrase 'survival of the fittest' is tautological or inverted. But we find empirically that behavior tends to coördinate in such ways that the reaction is accomplished with a *minimum of energy*—with the *least superfluous motion.* In the processes of growth and regulation a similar tendency is manifest. Vital processes tend to meet the conditions of the environment with a *diminishing expenditure of energy*—with *less friction* or waste motion. This seems to be the physicochemical meaning of fitness or harmony. It is an extension, through the operation of natural selection, of the general principle of equilibrium in nature.

Teleology, in the sense above defined, is the chief factor in producing the state of organic equilibrium called fitness. That is, *distant reception*, *memory*, and *anticipation* all tend to cut out waste motion and accelerate the tendency towards fitness. These processes, together with natural selection, may be regarded as but a further instance of that general 'harmony' which appears in all aspects of the universe.

I see, then, no real difficulty in subsuming anticipation and fitness under the general program of physicochemical mechanism. They may be treated as short-hand expressions for a certain complex type of causal phenomena. We do not regard the processes of multiplication and 'powering' in arithmetic as contradicting addition, nor as novel processes discontinuous with the latter. They are merely abbreviated methods of performing the addition process. In the same way the scientist may treat purposive activity or either of the other teleological modes as special, complex forms of causation falling under the general physicochemical type. Fitness may be regarded as a special, complex form of equilibrium. As such it belongs within the wider general sphere of mechanism.

HOWARD C. WARREN.

PRINCETON UNIVERSITY.